AD NUMBER

AD803545

NEW LIMITATION CHANGE

TO

Approved for public release, distribution unlimited

FROM

Distribution authorized to U.S. Gov't. agencies and their contractors; Administrative/Operational Use; OCT 1966. Other requests shall be referred to Air Force Systems Command, Wright-Patterson AFB, OH 45433.

AUTHORITY

afsc, usaf ltr, 2 mar 1972

MECHANICAL-PROPERTY DATA

AFC-77 STEEL

Tempered (1100 F) Sheet

Issued by

Air Force Materials Laboratory
Research and Technology Division
Air Force Systems Command
Wright-Patterson Air Force Base, Ohio

October, 1966

Prepared by

Battelle Memorial Institute
Columbus Laboratories
Columbus, Ohio 43201

AF 33(615)-2494

This data sheet was prepared by Battelle Memorial Institute under Contract AF 33 (615)-2494. The contract was initiated under Project No. 7381, "Materials Application", Task No. 738106, "Design Information Development". The major objectives of this program are to evaluate newly developed structural materials of potential Air Force weapons-system interest and then to provide data-sheet-type presentations of mechanical data. The program was assigned to the Structural Materials Engineering Division at Battelle under the supervision of Mr. Walter S. Hyler. Project engineer was Mr. Leman Beall, Jr.. The program was administered under the direction of the Air Force Materials Laboratory, Air Force Systems Command, Wright-Patterson Air Force Base, Ohio, by Mr. Marvin Knight, project engineer.

Notices

AFC-77

AFC-77 is a relatively new hardenable high-strength stainless steel developed for service at temperatures ranging from subzero to 1100 F. Below a tempering temperature of 900 F, the primary strengthening mechanism depends on precipitation reactions; above 1000 F, a secondary hardening reaction occurs with the formation of intermetallic compounds. A 500 F temper produces good ductility for cold forming. For optimum machining, a 1400 F temper is recommended. For elevated-temperature service, the 1100 F temper is appropriate. Improved toughness is obtained when a 700 F tempering temperature is used.

Good weld-joint efficiencies can be obtained using the semiautomatic inert-gas-shielded tungsten-electrode (TIG) process[1]*.

The alloy is commercially available as bar and forging.

AFC-77 SHEET DATA[a]

Condition: Quenched and Tempered 2 + 2 hr at 1100 F[b]
Thickness: 0.10 inch

Properties	Temperature, F			
	RT	600	800	1000
Tensile				
F_{tu} (longitudinal), ksi	289	253	240	204
F_{tu} (transverse), ksi	286	249	237	203
F_{ty} (longitudinal), ksi	205	201	190	163
F_{ty} (transverse), ksi	201	198	187	163
e_t (longitudinal), percent in 2 in.	7.7	6.7	7.7	10
e_t (transverse), percent in 2 in.	7.7	6.5	7.5	10
E_t (longitudinal), 10^6 psi	31.2	28.1	27.7	25.6
E_t (transverse), 10^6 psi	30.3	28.0	27.5	25
Compression				
F_{cy} (longitudinal), ksi	242	224	215	193
F_{cy} (transverse), ksi	246	230	220	194
E_c (longitudinal), 10^6 psi	32.4	31.4	30.4	28.5
E_c (transverse), 10^6 psi	32	31.8	30.5	28.4
Impact (Bar)				
(V-notch Charpy) ft-lb[2]	4	NA[c]	NA	NA
Fracture Toughness				
K_{Ic}, ksi $\sqrt{in.}$	23.1[d]	U[e]	124	NA
Bend				
(Transverse)	(f)	U	U	U

*See references at end.

Properties	Temperature, F RT	600	800	1000
Shear, F_s				
(Longitudinal), ksi	173	U	U	U
(Transverse), ksi	173	U	U	U
Axial Fatigue				
(Transverse)				
10^3 (K_t = 1) (R = 0.1), ksi(g)	292	266	260	U
10^5 (K_t = 1) (R = 0.1), ksi	148	162	170	U
10^7 (K_t = 1) (R = 0.1), ksi	130	124	116	U
10^3 (K_t = 3) (R = 0.1), ksi	210	198	180	U
10^5 (K_t = 3) (R = 0.1), ksi	80	74	68	U
10^7 (K_t = 3) (R = 0.1), ksi	64	60	56	U
Creep				
(Transverse)				
0.5% elongation 100 hr, ksi	NA	NA	200	110
0.5% elongation 1000 hr, ksi	NA	NA	190	90
Stress Rupture				
Rupture 100 hr, ksi	NA	NA	NA	150
Rupture 1000 hr, ksi	NA	NA	NA	130
Stress Corrosion				
80% F_{ty} 1000 hr max	3-5 days(h)	U	U	U
Coefficient of Thermal Expansion				
77 to 1000 F	6.37×10^{-6} in./in./F			
Density	0.282 lb/in.^{3}			
Ductile-to-Brittle Bend-Transition Temperature, F		(f)		

(a) Data are from tests conducted at Battelle under the subject contract unless otherwise indicated. In most cases data are average values for three tests. Fatigue, creep, and stress-rupture values are from data curves generated using the results of a greater number of tests.

(b) Treatment: 1/4 hr at 1900 F, OQ: 1/2 hr at -100 F, 2 + 2 hr at 1100 F.

(c) Information not applicable.

(d) Fatigue-cracked center-notched specimens (0.080" x 3" x 12").

(e) Information unavailable.

(f) Bend specimens were tempered 2 + 2 hr at 1400 F. No breaks occurred for a 4.5 T bend radius at RT, 50 F, 25 F, and -50 F. However, the 4.5 T bend produced cracks at 0 F for a 95° bend angle.

(g) "K_t" represents Neuber-Peterson theoretical stress-concentration factor. "R" represents algebraic ratio of the minimum stress to the maximum stress in one cycle, that is, $R = S_{min}/S_{max}$.

(h) Alternate immersion, 3-1/2% NaCl.

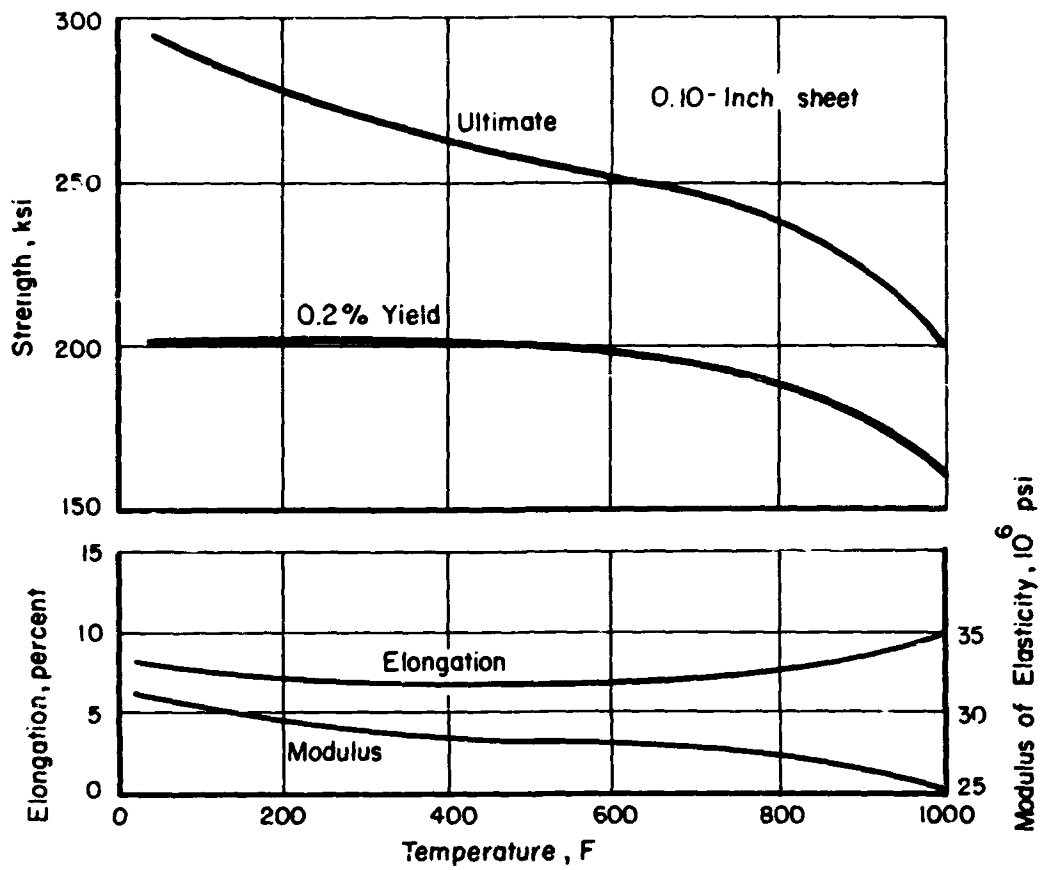

FIGURE 1. EFFECT OF TEMPERATURE ON THE TENSILE PROPERTIES OF AFC-77 SHEET (1100 F TEMPER)

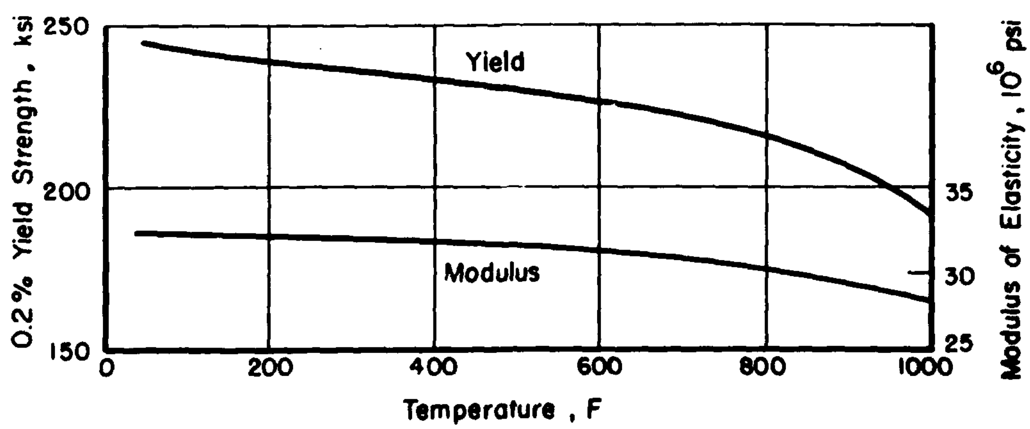

FIGURE 2. EFFECT OF TEMPERATURE ON THE COMPRESSION PROPERTIES OF AFC-77 SHEET (1100 F TEMPER)

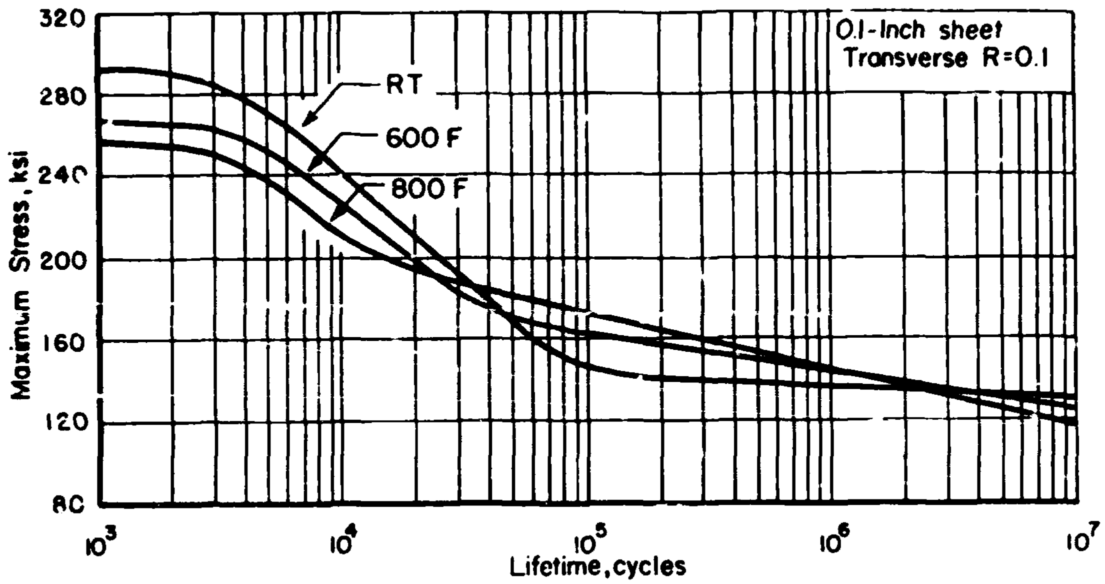

FIGURE 3. AXIAL-LOAD FATIGUE RESULTS FOR AFC-77 SHEET (1100 F TEMPER) AT THREE TEMPERATURES

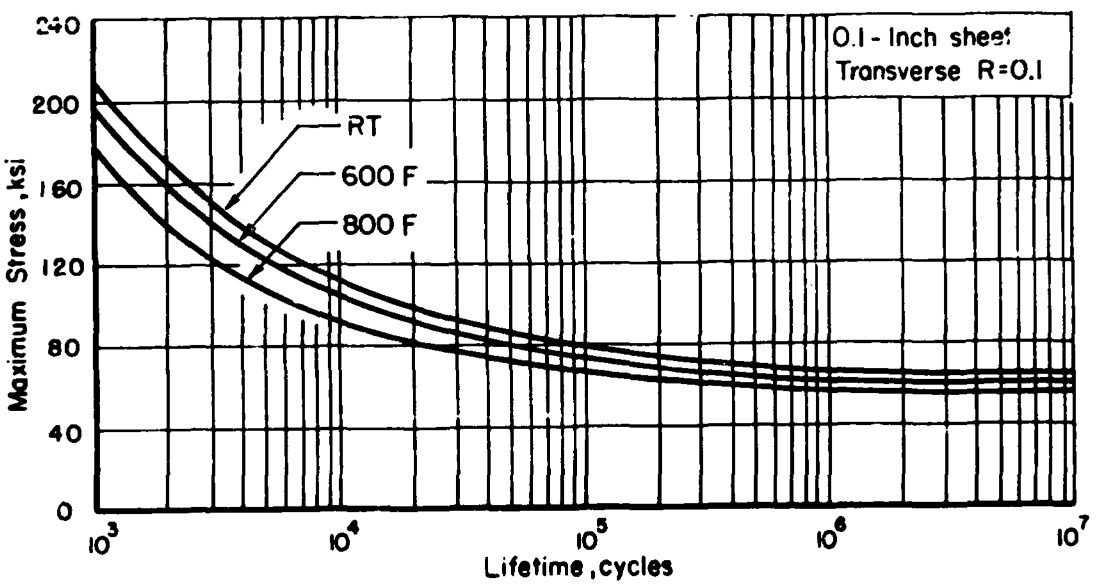

FIGURE 4. AXIAL-LOAD FATIGUE RESULTS FOR NOTCHED (K_t = 3.0) AFC-77 SHEET (1100 F TEMPER) AT THREE TEMPERATURES

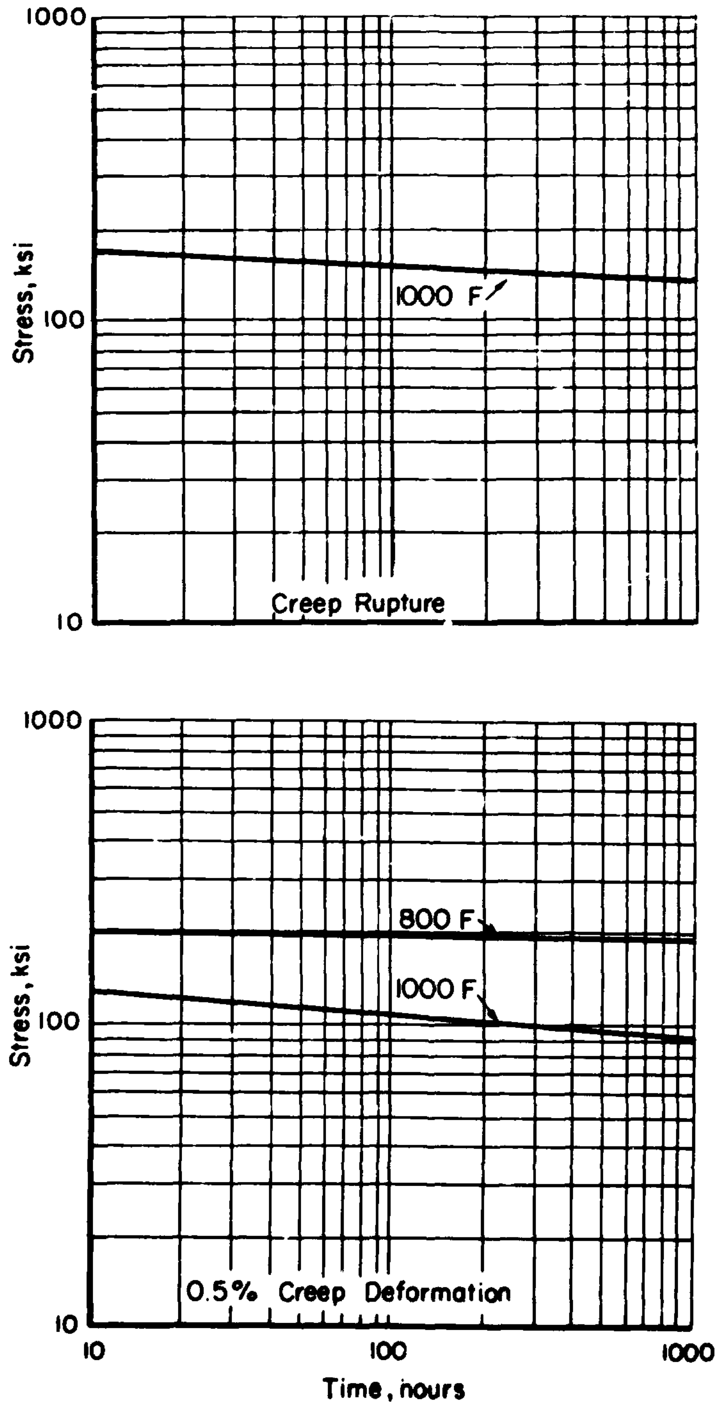

FIGURE 5. STRESS-RUPTURE AND 0.5% DEFORMATION CURVES FOR AFC-77 SHEET (1100 F TEMPER)

REFERENCES

(1) Kasak, A., Chandhok, V. K., and Dulis, E. J., "Development of New and Useful Elevated-Temperature Steels for Aircraft Applications", Crucible Steel Company of America, Report ASD TR 61-386 (June, 1962).

(2) Kasak, A., Chandhok, V. K., Moll, J. H., and Dulis, E. J., "Development of High-Strength Elevated-Temperature Corrosion-Resistant Steel", Crucible Steel Company of America, Report ASD TDR 63-766 (September, 1963).